Remarks

All previously pending claims were rejected based on U.S. patent 4,871,779 ("Killat et al.), or U.S. patent 5,714,166 ("Tomalia et al.), or U.S. patent application publication 2002/0102434 ("Inoue et al.), or Inoue et al. in view of a Baldo et al. article. In view of the amendment above and remarks below, reconsideration is respectfully requested.

Non-Substantive Issues

On page 3 of the Office Action claim 15 was noted as rejected. That claim has already been cancelled (as acknowledged on the summary sheet). Hence, the reference to claim 15 on page 3 is assumed to be a typo, and will not be further responded to.

An unintended deletion was made in the preliminary amendment of "wherein" in claim 14. That has now been corrected.

Previous claims 29 to 32 and 34, cancelled upon entry into the US national phase, have been reinstated as new claims, albeit dependent from amended base claims.

Substantive Amendments

Claims 1 and 24 (and thus all other still pending claims) have been amended to specify that the claimed compositions are charge-transporting and/or emissive. Proper basis for this amendment is found throughout the specification, and with particular reference to page 4, lines 24-26 (which make clear that films formed from the claimed compositions can be used as charge-transport layers and as emissive layers). While the claimed compositions will inherently demonstrate the desired electronic properties, claims 1 and 24 have nevertheless been amended to stress this distinction.

Anticipation

(a) Claims 1, 3-5, 11-14 and 16 were rejected as anticipated by Killat et al. The Office Action asserted that this document taught dendritic star polymers and in particular a composition comprising a second generation dendrimer and a third generation dendrimer having the same core (see column 18, lines 61 to 67, Example 6).

The passage relied upon in the Office Action discloses a

second generation dendrimer which is a polyamidoamine dendrimer with methacrylate terminal groups and a third generation dendrimer which is similar to DS-3 of Table II (but which, notably, must therefore be in some ways different from DS-3). Dendrimer DS-3 would appear to be a polyamidoamine, being based upon Example 1 of US 4,507,466.

There is no disclosure that the dendrimers in Killat et al. have the same core and the same repeating unit, yet have different generation numbers and/or different numbers of dendrons. Accordingly, this is a sufficient reason alone why Killat et al. should not be held to anticipate.

Additionally, in the examples of Killat et al. it appears that two dendrons having different surface groups are mixed, and then subsequently undergo a chemical reaction to form a film or resin (the observance of ester stretches in the infrared spectrum to amide). This is in contrast to present claim 1, where the final product is a blend of dendrimers, rather than a resin formed by the reaction of dendrimers. The subject matter of claim 1 should not be held anticipated by Killat et al. for this reason as well.

Furthermore, claim 1 (as amended) now requires that the compositions are charge-transporting and/or emissive. There is no disclosure of charge-transporting and/or emissive properties in Killat et al. This is another reason why Killat et al. should not be held to anticipate.

(b) Claims 1-6 and 8-17 have been rejected as anticipated by Tomalia et al. This document mentions at column 44, lines 37 to 42 that mixed dendrimers of different generations can be used. For example, it states that "combinations of two different sized dendrimers complexed with DNA can enhance transfection". However, this is not a disclosure of a mixture of dendrimers having (1) the same core, and (2) the same repeating unit.

The Office Action also references column 104, line 1 to column 105, line 43 of Tomalia et al., referring to compositions P and Q which relate to blends of dense star dendrimers. Again, although combinations of different dendrimers are disclosed, there is no disclosure of

combinations of dendrimers having (1) the same core, and (2) the same repeating unit.

The Office Action then refers to column 16, line 56 to column 17, line 15 and column 19, lines 11 to 28 of Tomalia et al. suggesting that the dendrimers can include fluorescent and phosphorescent emitting entities. However, when read in context the passages actually disclose that "M", which is a "carried material", can be a signal generator, for example a fluorescing entity, or can contain phosphorescent and fluorescent entities, for example luciferase and alkaline phosphatase. Accordingly, there is no disclosure that the dendrimers alone would be charge-transporting and/or emissive. In particular, there is certainly no mention of charge-transporting and/or emissive properties in combination with (1) a blend of dendrimers, (2) dendrimers having the same core, and (3) dendrimers having the same repeating unit. Again, this confirms why claim 1 should not be held anticipated by Tomalia et al.

Having demonstrated that the subject matter of claim 1 is not anticipated by either Killat et al or Tomalia et al, it is respectfully submitted that the remaining claims, all of which depend from or refer to claim 1, are also not anticipated.

Obviousness

(a) Claims 2 and 6 were rejected as obvious based on Killat et al. The Office Action suggested that it would have been obvious to use mixtures of dendrimers of different generations as disclosed in Killat et al. with the expectation of achieving the same properties. However, it should be considered that Killat et al. (and also Tomalia et al.) are in fields remote from the present invention. Killat et al. relates to ion exchange resins and chelate resins and makes no mention of organic light-emitting devices or, indeed, any form of charge transport or emission. Accordingly, one of ordinary skill in the art would not consider Killat et al. when seeking to provide improved light-emitting devices in accordance with the present invention.

(b) Claims 1, 3-5, 11, 12, 14 and 16 have been rejected as obvious based on Inoue et al. The Office Action correctly

notes that Inoue et al. does not use a plurality of compounds of formula (I) in combination, but suggests that it would have been obvious to use such a plurality.

While Inoue et al. does relate to a somewhat related technical field, and aims to provide organic electroluminescent devices, it does not teach mixtures of dendrimers, as noted above. In fact, there is no suggestion in Inoue et al. that the compounds disclosed therein are in fact dendrimers. Furthermore, there is certainly no teaching or suggestions that a mixture of dendrimers having the same core and the same repeating unit but different generations of dendrons and/or different numbers of dendrons could be used.

Although paragraph [0148] does mention using more than one compound in combination, this is certainly not the same as requiring one or more dendrimers in combination wherein the dendrimers have the same core and the same repeating unit but different generations of dendrons and/or different numbers of dendrons. Paragraph [0148] makes no suggestion that the compounds to be combined should have a close structural association, much less that they should have the same core and repeating unit but different generations of dendrons and/or different numbers of dendrons. For this reason it is submitted that claim 1 is not obvious based on a consideration of Inoue et al.

(c) Claims 2, 8, 9, 10, 24 and 26-28 have been rejected as obvious based on Inoue et al in view of Baldo et al. In particular, the Office Action suggests that it would have been obvious to expect the higher generation dendrimers of Inoue et al. to exhibit similar fluorescent and phosphorescent properties of the generation 1 dendrimer, TPD, due to the structural similarity between the compounds. The Office Action then suggests that it would have been obvious to use the dendrimers as host materials in the light emitting layer as taught by Baldo et al. with the expectation that the materials would provide light emission and high hole mobility.

In response to this rejection, it is first noted that one of ordinary skill in the art would not have thought to combine Baldo et al. and Inoue et al. Baldo et al. relates to the

specific instance of guest-host systems, and would not necessary be seen as directly compatible with the teaching of Inoue et al.. Furthermore, the Baldo et al. reference is not relevant to the current claims because the guest-host systems described therein relate to fluorescent hosts and guests which are emissive due to the energy transfer. In other words, the emissive and charge transport properties of the two materials are completely different. In contrast, the claimed blend of dendrimers of the present invention is the charge transporting and/or emissive component: there is no requirement for a guest-host system.

Furthermore, even if one of ordinary skill in the art did have knowledge of both Inoue et al. and Baldo et al., there would be no motivation to make mixtures of dendrimers with (1) the same core, and (2) the same repeating unit, but where the number of dendrons and/or the generation of the dendrons differs. In particular, there is no teaching in either document to suggest that a blend would provide desirable properties.

In addition, it should be noted that according to Baldo et al., the material TPD is only phosphorescent at -263ºC, which is clearly an impractical operating temperature. In comparison the claimed blends of dendrimers operate in a much more practical temperature range. If the Office Action's reasoning is followed, the skilled person would expect the higher generation compounds of Inoue et al. to have similar fluorescent and phosphorescent properties as TPD. The skilled person would therefore conclude that the higher generation compounds of Inoue et al. would only be phosphorescent at very low temperatures (around -260ºC). This would clearly be inappropriate for most technical applications. As such, the skilled person would not be led to combine the teaching of Baldo et al. and Inoue et al.

Furthermore, the Office Action's comment that the Inoue et al. materials would have similar emitting properties to TPD is incorrect. The pyrene derivative on page 50 of Inoue would have completely different emissive properties to TPD and may in fact quench the luminescence of the $Ir(ppy)_3$ complex

described in Baldo et al.

In view of the arguments above, one of ordinary skill in the art would not consider combining the teaching of Inoue et al. and Baldo et al. when seeking to provide new and inventive dendrimer compositions for light emitting devices. Even if the teachings of these documents were to be combined, it is not clear how this should be achieved because the teachings are at least in part incompatible (e.g. Baldo et al. relates to a guest-host system, which is different from the system in Inoue et al.).

The combination of the two documents would certainly not lead to the blends claimed in claim 1 of the present invention. In addition, the properties of the components used in the Baldo et al. and Inoue et al. systems would not be expected to be the same. Accordingly, this would suggest to the skilled person that a combination of the materials of these documents would not be advantageous. In fact, if the pyrene compounds of Inoue et al. were combined with the $Ir(ppy)_3$ complex of Baldo et al., this may in fact have an adverse effect on electroluminescent properties. For these reasons, it would not be obvious to combine Inoue et al. and Baldo et al., and we therefore submit that the subject matter of claim 1 is non-obvious over these documents.

Having demonstrated that the subject matter of claim 1 is non-obvious over the cited documents, it is respectfully submitted that the remaining claims, all of which depend from or refer back to claim 1, are also non-obvious.

(d) Apart from the above arguments, we also take this opportunity to submit additional data relating to the claimed compositions in further support of the unobviousness of the invention. One of the problems which the invention seeks to address is to provide light emitting devices having improved efficiency and lifetime. It is acknowledged that some of the data provided in the specification do not allow a clear comparison to be made between the compositions of the invention and those of the prior art. To rectify this, we can now provide an updated table of technical data supplied by the inventors to the undersigned which allows additional

comparisons to be made between a composition of the invention and compositions of the prior art. The updated table is as follows:

	Example	Comparative Example 1	Comparative Example 2
Max. power efficiency (cd/A)	35 - 39	17	23
Quantum efficiency (lm/W)	4-6V: 20-25	7.5V: 8	6V: 12
Brightness (cd/m2)	6V: 38	6V: 184-198	6V: 80
Max. observed brightness	12V: 4000	12V: 16000	10V: 1000

As noted earlier, an aim of the invention is to provide devices having improved efficiency. Accordingly, the most relevant rows of the table above are those relating to the maximum power efficiency and the quantum efficiency. Efficiency of devices is important because it impacts on, *inter alia*, battery life, heat generation and the load on the drive electronics, and is therefore very important.

Reviewing the efficiency figures, it can be seen that the maximum power efficiency for the composition of the invention (comprising a blend of dendrimers) is indicated by the inventors to be twice that of the first generation dendrimer alone (comparative example 1) and is indicated by the inventors to be 50% higher than the second generation dendrimer alone (comparative example 2). This maximum power efficiency (measured in cd/A) has more of the character of a quantum efficiency (but also weighted by the eye response) and, as the comparison above shows, demonstrates a substantial efficiency advantage for compositions according to the invention.

Similarly, the table above also shows that the quantum efficiency of the composition of the invention is around 2-3 times higher than that of the comparative examples. This luminous efficiency (measured in lm/W) refers to the light

emitted divided by the electrical power in, and therefore takes account of the slightly higher drive voltage for the comparative examples. In spite of this, there is still a major efficiency advantage.

In the light of the above supplemental data, there are clear and significant improvements in efficiency when compositions of the invention are used compared with prior art compositions. The invention therefore solves the problem of providing organic light emitting devices with improved efficiency and lifetime.

Conclusion

Having demonstrated that the current claims are not anticipated and should not be held obvious, reconsideration and allowance of the remaining amended claims is respectfully requested. As there are now twenty-four claims (due to the reinstatement via new claims of some subject matter), please charge Deposit 17-0055 for the additional four claims ($200). Further, a one month extension petition, plus fee authorization, is attached.

Apart from this, no additional fees are believed necessary for the entry of this amendment. However, if any are, please charge Deposit Account 17-0055 for the amount of the fee.

Respectfully submitted,

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